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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/653,828	09/03/2003	Paul A. Martin	004-7982	4116

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EXAMINER	
RAYYAN, SUSAN F	
ART UNIT	PAPER NUMBER
2167	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/11/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/653,828	MARTIN ET AL.	
	Examiner	Art Unit	
	Susan F. Rayyan	2167	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 03 September 2003.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-33 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-33 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 03 September 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 1/31/06,1/8/06,12/05,7/04.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-33 are pending.

Information Disclosure Statement

2. The information disclosure statements (IDS) submitted on July 19, 2004, December 19,2005, January 8, 2006 and January 31, 2006 were filed before First Office Action. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 1-13 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. Claim 1, omits all method steps.

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-13 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. Method steps critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re*

Mayhew, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). Method (implementation) steps are critical to the implementation of an invention and claim 1 does not provide method steps.

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

the claimed invention is directed to non-statutory subject matter.

Claim 1 recites "An implementation of a key-value dictionary shared object for which all concurrent executions of insert-type and delete-type operations thereon are linearizable and lock-free". The claim does not provide methods steps and therefore does not provide useful, concrete and tangible results.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by US 7,117,502 issued to Timothy L. Harris ("Harris").

As per claim 1 Harris anticipates:

An implementation of a key-value dictionary shared object for which all concurrent executions of insert-type and delete-type operations thereon are linearizable and lock-free (column 2, lines 29-43 and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free) and linearizable, supports insert and delete operations) .

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 2-13 , are rejected under 35 U.S.C. 103(a) as being unpatentable over US 7,117,502 issued to Timothy L. Harris ("Harris") in view of "Skip Lists: A Probabilistic Alternative to Balanced Trees" by William Pugh ("Pugh").

As per claim 2 same as claim arguments above Harris does not explicitly teach organized as a skip-list-type data structure with associated functional encodings of insert-type and delete-type operations ... Pugh does teach this limitation (page 1, section Skip Lists and Figure 1, as skip list data structures and page 2 section Insertion and Deletion Algorithms, as insert and delete nodes) to provide space efficiency and speed improvement. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Harris with organized as a skip-list-type data structure with associated functional encodings of insert-type and delete-type operations to provide space efficiency and speed improvement (page 1, third paragraph).

As per claim 3 same as claim arguments above and Pugh teaches:

wherein the skip-list-type data structure includes:

plural nodes (Figure 1); and

at least two referencing chains including a first-level referencing chain that traverses the nodes in accordance with an ordering thereof and an Nth-level referencing chain that traverses at least a subset of the nodes in accordance with the ordering (Figure 1, element b includes a first level which points to each node (head->3->6->7->9) and Nth-level which points to a subset (head->6->9->19->).

As per claim 4 same as claim arguments above and Pugh teaches:

wherein a dead pointer indication is employed to mark a node in process of being excised from the skip-list-type data structure (page 2, Section Insertion and Deletion lines 2-7, update contains the pointer and Figures 3-4) .

As per claim 5 same as claim arguments above and Pugh teaches:

wherein the dead pointer indication includes one of: a self pointer, a pointer to a dead node and a back pointer (page 2, Section Insertion and Deletion lines 2-7, update contains the pointer and Figures 3-4).

As per claim 6 same as claim arguments above and Pugh teaches:

wherein, for the insert-type operations, the employed linearizable synchronization operations include a single-target synchronization primitive employed to introduce a new node into a first-level referencing chain of the skip-list-type data structure (Figure 3 and lines 1-20 of Figure 4, insertion into a Skip list, 17 is inserted into the Skip List which include referencing chains).

As per claim 7 same as claim arguments above and Harris teaches:

a double-target synchronization primitive employed to update an existing node with a new value (column 3, lines 5-10,as CAP (Compare and Swap operations)).

As per claim 8 same as claim arguments above Pugh teaches:

wherein, for the insert-type operations, the employed linearizable synchronization operations include a double-target synchronization primitive employed

to introduce a new node into an Nth-level referencing chain of the skip-list-type data structure, wherein Nth-level is greater than first-level(Figure 3 and lines 1-20 of Figure 4, insertion into a Skip list, 17 is inserted into the Skip List which include referencing chains).

As per claim 9 same as claim arguments above and Pugh teaches:

wherein, for the delete-type operations, the employed linearizable synchronization operations include a double-target synchronization primitive employed to excise a node from a referencing chain of the skip-list-type data structure (lines 21-36 of Figure 4, delete operation on a node).

As per claim 10 same as claim arguments above and Pugh teaches:

a definition of a node instantiable in shared memory to represent a key-value pair(page 1, Section Skip List Algorithm lines 1-4, key value).

As per claim 11 same as claim arguments above and Pugh teaches:

wherein values in the key-value dictionary shared object include literal encodings of values (page 1, Section Skip List Algorithm lines 1-4, key value).

As per claim 12 same as claim arguments above and Pugh teaches:

wherein values in the key-value ... shared object include references to a literal value or data structure (page 1, Section Skip List Algorithm lines 1-4, key value).

As per claim 13 same as claim arguments above and Harris teaches:

wherein the concurrent executions are mediated by compare-and-swap (CAS) and double-compare-and-swap operations (column 3, lines 5-10, CAS).

Claims 14-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Skip Lists: A Probabilistic Alternative to Balanced Trees" by William Pugh , herein after ("Pugh") in view of US 7,117,502 issued to Timothy L. Harris ("Harris").

As per claim 14 Pugh teaches:

instantiating nodes of the shared data structure in memory, wherein plural levels of same-direction referencing chains traverse respective subsets of the nodes in accordance with a key ordering relationship thereof, a first-level of the referencing chains traversing each node of the shared data structure and at least one other level of the referencing chains traversing less than all nodes of the shared data structure(Figure 1, element b includes a first level which points to each node (head->3->6->7->9) and Nth-level which points to a subset (head->6->9->19->).

Pugh does not explicitly teach operating on the shared data structure using insert-type and delete-type operations that are linearizable and lock-free for all concurrent executions thereof . Harris does teach this limitation at (column 2, lines 29-43 and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free)

and linearizable, supports insert and delete operations) to lower contention and increase concurrency. It would have been obvious to one of ordinary skill in the art to modify Pugh with operating on the shared data structure using insert-type and delete-type operations that are linearizable and lock-free for all concurrent executions thereof to lower contention and increase concurrency (abstract , lines 8-9).

As per claim 15 same as claim arguments above Pugh teaches:

wherein the insert-type operation performs a synchronized update of pointers beginning at the first level thereof and continuing upward (see Figure 1, insert operation and pointers);

wherein the delete-type operation performs a synchronized update of pointers beginning at a Kth level thereof and continuing downward to the first level (see page 2, Section Insertion and Deletion Algorithms, updating pointers).

As per claim 16 same as claim arguments above Pugh teaches:

wherein the insert-type operation performs a synchronized update of pointers in accordance with a first succession of the levels(see Figure 1, insert operation and pointers);

and wherein the delete-type operation performs a synchronized update of pointers in accordance with a second succession of the levels, the second succession opposing the first succession(see page 2, Section Insertion and Deletion Algorithms, updating pointers).

As per claim 17 same as claim arguments above Pugh teaches:

for a given one of the nodes instantiated, dynamically selecting a number of the plural, same-direction referencing chains that traverse the given node (Figure 2, Skip List search algorithm).

As per claim 18 same as claim arguments above Pugh teaches:

wherein the shared data structure implements a dictionary (page 1, Skip List Section ,lines 1-2, dictionary).

As per claim 19 same as claim arguments above Pugh teaches:

wherein values are associated with respective ones of the keys, the method further as part of an execution of the insert-type operation introducing a value into the shared data structure(see Figure 3, node 17 is inserted);

and as part of an execution of the delete-type operation removing a value from the shared data structure the removed value corresponding to a search key (page 2, section Insertion and Deletion , delete type operation).

As per claim 20 same as claim arguments above Pugh teaches:

wherein the correspondence includes a greater-than-or-equal-to key match criterion (page 2, Figure 2, Skip List search algorithm, searchkey)

As per claim 21 Pugh teaches:

plural levels of same-direction referencing chains that traverse respective subsets of the nodes in accordance with a key ordering relationship thereof, a first of the referencing chains traversing each node of the shared data structure and a second of the referencing chains traversing less than all nodes of the shared data structure(Figure 1, element b includes a first level which points to each node (head->3->6->7->9) and Nth-level which points to a subset (head->6->9->19->).

Pugh does not teach plural nodes and a functional encoding of linearizable operations on the shared object, wherein the linearizable operations include both insert-type and remove-type operations and are lock-free for all concurrent executions thereof. Harris does teach this limitation at (Figure 3, column 2, lines 29-43 and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free) and linearizable, supports insert and delete operations) to lower contention and increase concurrency. It would have been obvious to one of ordinary skill in the art to modify Pugh with plural nodes and a functional encoding of linearizable operations on the shared object, wherein the linearizable operations include both insert-type and remove-type operations and are lock-free for all concurrent executions thereof to lower contention and increase concurrency (abstract , lines 8-9).

As per claim 22 same as claim arguments above Pugh teaches:

wherein, on at least some executions, the insert-type introduces an additional node into at least one of the referencing chains (see Figure 3, node 17 is inserted).

As per claim 23 same as claim arguments above Pugh teaches:

wherein, on at least some executions, the delete-type operation excises a particular node from all referencing chains that traverse the particular node (lines 21-36 of Figure 4 and page 2,Section Insertion and Deletion, delete type operation).

As per claim 24 same as claim arguments above Pugh teaches:

wherein the delete-type operation employs a greater-than-or-equal-to key match criterion (lines 1-4 of Figure 4, delete operation).

As per claim 25 same as claim arguments above Pugh teaches:

wherein the shared object implements a shared skip-list-type data structure (page 1, Section Skip List , skip list data structure).

As per claim 26 same as claim arguments above Pugh teaches:

wherein the shared object implements a dictionary data structure (page 1, Skip List Algorithm , dictionary structure).

As per claim 27 Pugh teaches:

In a computational system that employs a shared list-type data structure that includes plural nodes and plural levels of referencing chains that traverse respective ones of the nodes in accordance with an ordering thereof, wherein a higher-level one of the

referencing chains traverses no more than a subset of the nodes traversed by a lower-level one of the referencing chains(Figure 1, element b includes a first level which points to each node (head->3->6->7->9) and Nth-level which points to a subset (head->6->9->19->);

deleting a node from the shared list-type data structure by excising the node from successive ones of the referencing chains, beginning with a highest-level one of the referencing chains that traverses the node and continuing through a lowest-level one of the referencing chains, wherein each such excision employs a linearizable synchronization operation to bridge the excised node and associate a dead pointer indication therewith (lines 21-38 of Figure 4, delete node and Section Insertion and Deletion Algorithm of page 2,update contains pointer) ;

inserting a node into the shared list-type data structure by introducing the inserted node into one or more of the referencing chains, beginning with the lowest-level referencing chains and continuing through successive zero or more higher-level referencing chains (Figure 3, Inserting node).

Pugh does not explicitly teach facilitating lock-free concurrent operations on the shared list-type data structure. Harris does teach this limitation (column 2, lines 29-43 and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free) and linearizable, supports insert and delete operations) to lower contention and increase concurrency. It would have been obvious to one of ordinary skill in the art to modify Pugh with teach facilitating lock-free concurrent operations on the shared list-type data structure to lower contention and increase concurrency (abstract , lines 8-9).

As per claim 28 same as claim arguments above Harris teaches:

wherein all concurrent executions of the deleting and the inserting are linearizable and lock-free(column 2, lines 29-43 and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free) and linearizable, supports insert and delete operations) .

As per claim 29 same as claim arguments above Pugh teaches:

wherein the dead pointer indication includes one: a self pointer, a pointer to a dead node, a back pointer (page 2, Section Insertion and Deletion lines 2-7, update contains the pointer and Figures 3-4).

As per independent claim 30 Pugh teaches:

defining a shared list-type data structure that includes plural nodes and plural levels of same direction referencing chains that traverse at least some of the nodes in accordance with an ordering thereof, wherein a higher-level one of the referencing chains traverses no more than a subset of the nodes traversed by a lower-level one of the referencing chains(Figure 1, element b includes a first level which points to each node (head->3->6->7->9) and Nth-level which points to a subset (head->6->9->19->).

Pugh does not explicitly teach inserting into, and deleting from, the shared list-type data structure, wherein all concurrent executions of the deleting and the inserting are linearizable and lock-free. Harris does teach this limitation at (column 2, lines 29-43

and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free) and linearizable, supports insert and delete operations) to lower contention and increase concurrency. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Pugh with inserting into, and deleting from, the shared list-type data structure, wherein all concurrent executions of the deleting and the inserting are linearizable and lock-free to lower contention and increase concurrency (abstract).

As per claim 31 same as claim arguments above Pugh teaches:
a definition of a skip list instantiable in storage (page 1, section Skip Lists and Figure 1, as skip list data structures and page and page 2 section Insertion and Deletion Algorithms, as insert and delete nodes).

Pugh does not explicitly teach lock-free means for coordinating concurrent and linearizable executions of both insert-type and delete-type operations. Harris does teach this limitation at (column 2, lines 29-43 and column 4, lines 65 to column 5, lines 33, concurrent processes, non-blocking (lock-free) and linearizable, supports insert and delete operations) to lower contention and increase concurrency. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Pugh with lock-free means for coordinating concurrent and linearizable executions of both insert-type and delete-type operations to lower contention and increase concurrency (Abstract).

As per claim 32 same as claim arguments above Harris teaches: the storage (Figure 1, element 103, memory).

As per claim 33 same as claim arguments above Harris teaches:

plural processors, the insert-type and delete-type operations executable thereon (Figure 1, element 101: processors).

Contact Information

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Susan Rayyan whose telephone number is (571) 272-1675. The examiner can normally be reached M-F: 8am - 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Cottingham can be reached on (571) 272-7079. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Susan Rayyan

January 5, 2007

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